Reproductive condition, moult, and body mass of birds from Isabel, Solomon Islands

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With 61 species confined to the archipelago, the Solomon Islands (including Bougainville) have one of the world's most distinctive avifaunas (Stattersfield *et al.* 1998). Despite this uniqueness, the natural history of Solomon Island birds remains poorly known. Although recent treatments by Webb (1992) and Kratter *et al.* (in press) have substantially increased our knowledge of the avifauna on Isabel Island, one the main islands in the archipelago, nothing has been published about the timing of breeding and moult in birds on Isabel, as is largely the case throughout the Solomons (but see Sibley 1951 and Schodde 1977). Body masses from some widespread Solomon Island species that occur on Isabel were given by Galbraith & Galbraith (1962), Schodde (1977), and Dunning (1993), yet most of these data were based on small samples from other islands.

Aside from a small collection made in 1995 (H.P. Webb & M. LeCroy, pers. comm.), birds have not been collected on Isabel since the Whitney South Seas expedition in 1927, which obtained series of skins for most species on Isabel but did not preserve skeletal specimens, tissue samples or spread wings. Locality data were imprecise at best. The most recent techniques in specimen preparation (including saving skin, skeleton, and tissues samples from the same individual) and data recording (see Winker 2000) have opened up new avenues for research into fields including phenology (e.g., moult, reproduction, fat levels), blood parasites (Steadman *et al.* 1990), food habits (Franklin & Steadman 1991), prehistoric extinctions (e.g., Steadman 1995), and systematics (e.g., inferring relationships from sequencing DNA). These developments have led to a much-improved ecological, taxonomic, and historical basis for identifying conservation priorities in Oceania.

In 1997-98, we visited several sites on Isabel, as well as four islets just off the main island. We made detailed observations of the avifauna and prepared specimens collected by local hunters. In a sister paper (Kratter *et al.* in press), we focus on community patterns of the avifauna at a lowland forest site (Garanga River), including some new records for the island and discussion of conservation issues. In this paper, we present data on reproductive condition, moult, and body mass of Isabel's birds.

Study sites and methods

Isabel, the third largest island in the Solomon archipelago (3995 km^2), is a long (199 km) and narrow (in most places 20-25 km wide) island (Fig. 1). Our field research in east-central Isabel in 1997 and 1998 was undertaken at the following sites (Fig. 1):

1) lowland portions of the Garanga River (8°S, 159°E), described in detail in Kratter *et al.* (in press); 9-23 July 1997 and 22–29 June 1998.
2) Fera Island (8°05.5'S, 159°35'E), 123 ha islet 2.5 km north of Buala; 4 July 1997, 6, 9-10 July 1998. A grass airstrip is along the western edge of this flat island. The vegetation is rather dense with a low (< 25 m) canopy.
3) Sulei Island (8°04.5'S, 159°32'E), 87 ha islet, separated from the mainland by a narrow (*c.* 100 m wide) channel and 4 km northwest of Fera Island; 6, 9-10 July 1998. The vegetation on Sulei is much more developed than on Fera, with tall forest (canopy > 30 m) covering much of this slightly hilly island. Mangrove forests dominate the island's periphery.
4) Kiaba Island (8°00'S, 159°27'E), *c.* 2 ha islet, 2 km east of the mouth of the Garanga River; 6 July 1997, 21, 26 June 1998. The island is dominated by scrubby forest.
5) Hakelake Island (7°53'S, 159°14'E), a tiny islet (*c.* 1 ha); 8 July 1998. Coconut palms and scrubby forest ring the island, with a thicket of dense shrubs in the centre.
6) Longedo'u River (8°10.5'S, 159°35.0'E), middle elevation forest at 500 m; 1-4 July 1998. The hills in this area are covered in dense forest, with occasional small (< 1 ha) clearings for farm plots. Stands of bamboo (*Bambusa* sp.) up to 10 cm diameter occur adjacent to several farms. Epiphytic growth is much more pronounced than in lowland forests along the Garanga River. The Longedo'u River, *c.* 10 m wide at this elevation, is fast-running, with several short cascades.

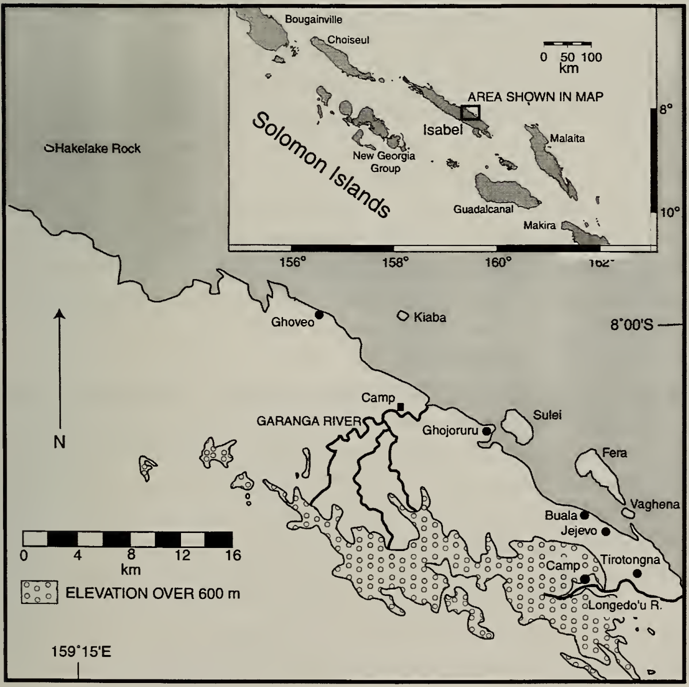

Fig. 1. Map of Isabel and offshore islets, showing study sites.

Our visits coincided with the April to September dry season of the Solomon Islands (Cain & Galbraith 1956, Blaber 1990). In general, the weather was mild to hot and humid, with partly cloudy to cloudy skies. Some rain occurred on most field days (7 days in 1997 and 5 days in 1998), including a series of storms from 15-18 July 1997. Winds were generally light.

Most birds were collected with shotguns by local hunters. Mark Hafe, an Isabel islander, hunted in both years and was thoroughly familiar with the plumages, vocalizations, and behaviour of all bird species on Isabel. To a much lesser extent, we also used ground-level mist nets at our Garanga River and Longedo'u River sites to collect birds in interior forest or across rivers. Specimens are housed at the Florida Museum of Natural History (UF), University of Washington Burke Museum (UWBM), and Solomon Islands National Museum (SINM). Tissues preserved in lysis buffer are stored at UWBM. Specimen tag data include sex, reproductive condition, moult scoring (remiges, rectrices, and body), soft part colours, subdermal fat levels, stomach contents (when present, saved and stored at UF), skull ossification, presence/absence of bursa, and habitat.

Results

We collected a total of 433 specimens, representing 70 species, in our two sessions of fieldwork on Isabel. Of these 70 species, 66 are residents, representing 87% of the 76 resident landbird species known from Isabel (Kratter *et al.* in press). The four non-resident or marine species were a shorebird migrant from the north (*Actitis hypoleucos* – vernacular names of all species are given in Table 1), two landbird migrants from the south (*Chrysococcyx lucidus* and *Halcyon sancta*), and a near-shore marine tern (*Sterna bergii*). The specimens of two species (*Amaurornis molucannus* and *Eudynamys scolopacea*) were the first to be collected on Isabel.

Most of the specimens (317, 73% of the birds collected) were collected at the Garanga River site (Kratter *et al.* in press). The others were distributed as follows: Longedo'u River, 44 specimens; Sulei Island, 29; Fera Island, 18; Kiaba Island, 17; and Hakelake Island, 8. Specimens collected on the islets are the first we know of from these locales.

Breeding

Although our sample represents only a fraction of the yearly cycle, there are few or no published data on breeding and moult cycles for almost all species of Solomon Island birds. Evidence of reproductive activity (in males, cloacal protuberance, enlarged testes, and/or enlarged seminal vesicles; in females, developing ova, presence of brood patch, and/or wide and convoluted oviduct) was found in 30 of the 63 species for which we collected adult specimens. Among the 27 species with five or more adult specimens (Table 1), 17 had at least one reproductively active individual (classified as "enl" in Table 2). These consisted of nine of 12 non-passerines and eight of 15 passerines. The only species with all (N=11) adult specimens in breeding condition was *Pachycephala pectoralis*, which is more territorial than most other local passerines. At least some gonadal evidence of reproductive activity was found in 23 of the 25 specimens for the highly frugivorous columbid genera (*Ptilinopus* and *Ducula*), 15 of 16 adult specimens for the three species of *Rhipidura*, and 26 of 43 adult specimens for the three species of *Monarcha*.

Evidence of breeding activity was rare, on the other hand, in starlings and mynas (1 of 30 adult specimens), parrots (2 of 36), kingfishers (3 of 35), and cuckoo-shrikes (4 of 27). Three of these four groups (two of four starlings and mynas, parrots, and kingfishers) are predominantly cavity nesters. However, the hornbill (*Aceros plicatus*), one of the two other cavity nesters at our site, was reproductively active. Both of our specimens of *Eurystomus orientalis*, the other cavity nester, are immatures, and thus we cannot assess reproductive activity for this species.

Moult

Intraspecific moult data were extremely variable (Table 2), suggesting that some species have protracted moult schedules, as is common in tropical birds (e.g., in Sarawak; Fogden 1972). Two groups of birds did not conform to this overall pattern. First, wing and tail moult was absent or nearly so in most or all adult individuals of *Ptilinopus viridis*, *Chalcopsitta cardinalis, Micropsitta finschii, Aceros plicatus, Coracina tenuirostris, Rhipidura cockerelli, Aplonis grandis, A. metallica,* and *Dicaeum aeneum*. Second, wing and/or tail moult were found in most or all individuals of *Nesoclopeus woodfordi, Cacatua ducorpsii, Monarcha castaneiventris, Mino dumontii*, and *Corvus woodfordi*. We see no clear pattern here in either a taxonomic sense or by feeding guild. To assess moult schedule more rigorously on a species by species basis, larger samples of specimens from throughout the annual cycle are needed.

Body mass

Our body mass data are the first to be published for four species (*Nesoclopeus woodfordi, Nesasio solomonensis, Pitta anerythra,* and *Monarcha cinerascens*). In addition, we report the first body mass data for the Solomon Islands for three other species (*Ixobrychus flavicollis, Amaurornis moluccanus,* and *Caloenas nicobarica*).

For the 45 species where we have data from both adult males and females (Table 1), we found no obvious (i.e., < 7.5%) sexual difference in body mass in 26 species (*Anas superciliosa, Aviceda subcristata, Megapodius [freycinet] eremita, Ptilinopus viridis, Ducula pistrinaria, Cacatua ducorpsii, Trichoglossus haematodus, Collocalia esculenta, Hemiprocne mystacea, Alcedo atthis, Halcyon sancta, H. saurophaga, Coracina papuensis, C. tenuirostris, C. holopolia, C. caledonica, Rhipidura cockerelli, Monarcha castaneiventris, M. barbata, M. cinerascens, Myiagra ferrocyanea, Pachycephala pectoralis, Aplonis cantoroides, A. grandis, Dicaeum aeneum,* and *Zosterops metcalfii*). Males averaged larger than females in 13 species (*Nesoclopeus woodfordi, Porphyrio porphyrio, Ptilinopus superbus, Chalcopsitta cardinalis, Micropsitta finschii, Aceros plicatus, Coracina lineata, C. papuensis, C. holopolia, Rhipidura leucophrys, Aplonis metallica, Mino dumontii,*

TABLE 1

Specimen data for birds collected on Isabel.
Age: imm = juvenal or immature (subadult plumage, and/or bursa present, and/or skull <100% ossified, the latter for doves through passerines only); adult = adult plumage and/or no bursa present and/or skull 100% ossified. Sites: GR = Garanga River, LR = Longodo'u River, FI = Fera Island, HI = Hakelake Island, SI= Sulei Island, KI = Kiaba Island; number of specimens of each class given for each site.
* species or subspecies endemic to the Solomon archipelago.

FAMILY & species	sites						
age & sex	GR	LR	SI	FI	KI	HI	mass (g)
ARDEIDAE							
Egretta sacra sacra Pacific Reef-Egret							
adult ♀	2	-	-	-	-	-	380, 440
Nycticorax caledonicus mandibularis Rufous Night-Heron							
adult ♂	1	-	-	-	-	-	750
*Ixobrychus flavicollis *woodfordi* Black Bittern							
adult ♀	1	-	-	-	-	-	337
imm ♂	1	-	-	-	-	-	320
Butorides striatus solomonensis Striated Heron							
adult ♀	1	-	-	-	-	-	226
ANATIDAE							
Anas superciliosa pelewensis Pacific Black Duck							
adult ♂	1	-	-	-	-	-	642
adult ♀	2	-	-	-	-	-	560, 640
imm ♂	3	-	-	-	-	-	590, 615, 635
ACCIPITRIDAE							
*Aviceda subcristata *gurneyi* Pacific Baza							
adult ♂	4	-	-	-	-	-	285, 298, 317, 356
adult ♀	2	-	-	-	-	-	319, 330
imm ♀	1	-	-	-	-	-	303
*Haliastur indus *flavirostris* Brahminy Kite							
adult ♂	1	-	-	-	-	-	606
*Haliaeetus *sanfordi* Sanford's Fish-Eagle							
subad ♂	1	-	-	-	-	-	1980
*Accipiter novaehollandiae *rufoschistaceus* Gray Goshawk							
adult ♂	2	-	-	-	-	-	172, 187
adult ♀	1	-	-	-	-	-	245
imm ♂	1	-	-	-	-	-	182
imm ♀	1	-	-	-	-	-	207
*Accipiter *imitator* Imitator Sparrowhawk							
adult ♂	1	-	-	-	-	-	208

MEGAPODIDAE							
Megapodius [*freycinet*] *eremita* Melanesian Scrubfowl							
adult ♂	1	-	-	-	-	-	810
adult ♀	1	-	-	1	-	-	795, 860
RALLIDAE							
*Amaurornis moluccanus *nigrifrons* Rufous-tailed Bush-hen							
adult ♂	-	1	-	-	-	-	229
*Nesoclopeus *woodfordi immaculatus* Woodford's Rail							
adult ♂	2	-	-	-	-	-	670, ?
adult ♀	5	-	-	-	-	-	410, 530, 533, 569, 571
imm ♂	4	-	-	-	-	-	457, 575, 623, 640
imm ♀	1	-	-	-	-	-	486
chick ♀	1	-	-	-	-	-	56
chick sex?	1	-	-	-	-	-	62
Porphyrio porphyrio samoensis Purple Swamphen							
adult ♂	1	-	-	-	-	-	918
adult ♀	1	-	-	-	-	-	615
SCOLOPACIDAE							
Actitis hypoleucos Common Sandpiper							
imm ♀	1	-	-	-	-	-	33.5
LARIDAE							
Sterna bergii cristata Crested Tern							
imm ♂	-	-	1	-	-	-	291
COLUMBIDAE							
*Macropygia mackinlayi *arossi* Mackinlay's Cuckoo-Dove							
adult ♂	-	2	1	1	-	-	76, 94, 100, 103
imm ♂	5	1	-	1	-	-	65.5, 72, 79.5, 82, 85, 89, 90
*Chalcophaps stephani *mortoni* Stephan's Dove							
adult ♀	1	-	-	-	-	-	123
Ptilinopus s. superbus Superb Fruit-Dove							
adult ♂	-	2	-	-	-	-	131, 139
adult ♀	1	3	-	-	-	-	121, 122, 124,132
Ptilinopus viridis lewisii Claret-breasted Fruit-Dove							
adult ♂	3	-	-	-	-	-	124, 125, 135
adult ♀	5	1	-	-	-	-	112, 114, 118, 118, 122, 124
*Ducula rubricera *rufigula* Red-knobbed Imperial-Pigeon							
adult ♂	3	-	-	-	-	-	560, 612, 638
adult ♀	4	-	1	-	-	-	610, 651, 655, 660, 765
Ducula p. pistrinaria Island Imperial-Pigeon							
adult ♂	-	-	-	-	1	-	520
adult ♀	-	-	1	-	1	-	501, 525
Caloenas n. nicobarica Nicobar Pigeon							
adult ♀	-	-	1	-	-	-	675

PSITTACIDAE							
Chalcopsitta *cardinalis *Cardinal Lory*							
adult ♂	7	-	-	-	-	-	220, 231, 234, 235, 240, 267, 268
adult ♀	1	-	-	-	-	-	221
imm ♂	1	-	-	-	-	-	220
Trichoglossus haematodus massena Rainbow Lorikeet							
adult ♂	1	-	-	-	-	-	109
adult ♀	2	1	-	-	-	-	98, 98, 111
*Cacatua *ducorpsii* Ducorps's Cockatoo							
adult ♂	4	-	-	-	-	-	383, 386, 402, 410
adult ♀	2	-	-	-	-	-	365, 386
*Micropsitta finschii *nanina* Finsch's Pygmy-Parrot							
adult ♂	12	-	-	-	-	-	11.1, 11.9 , 12.4, 12.5, 13.0, 13.2, 13.5, 13.6, 14, 14.1, 14.2, 15
adult ♀	2	-	-	-	-	-	11.3, 12.6
imm ♂	2	-	-	-	-	-	13.1, 14
imm ♀	-	2	-	-	-	-	11.4, 11.7
Eclectus roratus solomonensis Eclectus Parrot							
adult ♂	3	1	-	-	-	-	395, 405, 406, 440
imm ♂	-	1	-	-	-	-	375
Geoffroyus heteroclitus heteroclitus Singing Parrot							
adult ♀	-	1	-	-	-	-	169
CUCLIDAE							
Chrysococcyx lucidus lucidus Shining Bronze Cuckoo							
imm ♂	1	-	-	-	-	-	20.0
imm ♀	3	1	-	-	-	-	20, 22.8, 24.1, 25.8,
*Cacomantis variolosus *addendus* Brush Cuckoo							
imm ♀	1	-	-	-	-	-	49
*Eudynamys scolopacea *alberti* Asian Koel							
imm ♂	1	-	-	-	-	-	140
STRIGIDAE							
*Ninox *jacquinoti jacquinoti* Solomon Islands Hawk-Owl							
adult ♂	2	-	-	-	-	-	253, 260
adult ♀	1	-	-	-	-	-	277
*Nesasio *solomonensis* Fearful Owl							
adult ♀	-	1	-	-	-	-	1155
PODARGIDAE							
*Podargus ocellatus*inexpectatus* Marbled Frogmouth							
adult ♀	-	1	-	-	-	-	175
APODIDAE							
Collocalia vanikorensis lugubris Uniform Swiftlet							
adult ♀	-	-	-	1	-	-	11.2
*Collocalia esculenta *?becki* Glossy Swiftlet							
adult ♂	1	-	-	-	-	-	7.3
adult ♀	-	1	-	-	-	-	7.5

HEMIPROCNIDAE							
Hemiprocne mystacea woodfordiana Moustached Treeswift							
adult ♂	1	-	-	-	-	-	57
adult ♀	1	-	-	-	-	-	59
ALCEDINDAE							
*Alcedo atthis *salomonensis* Common Kingfisher							
adult ♂	5	-	-	-	-	-	25.8, 29.2, 29.5, 35, ?
adult ♀	4	-	-	-	-	-	28.5, 30, 32, 33
*Ceyx lepidus *meeki* Variable Kingfisher							
adult ♂	3	1	-	-	-	-	15, 16, 16.5, 18.1
adult ♀	1	2	-	-	-	-	16.7, 20.0, 22.5
imm ♀	1	-	-	-	-	-	19.4
*Halcyon *leucopygia* Ultramarine Kingfisher							
adult ♂	7	1	-	-	-	-	42.5, 45, 45.5, 45.7, 46, 47, 48, 49.1
adult ♀	2	-	1	-	-	-	42, 49, 61
imm ♂	-	-	-	1	-	-	49
Halcyon sancta Sacred Kingfisher							
adult ♂	1	-	-	-	-	-	42
adult ♀	-	-	1	-	-	-	43
imm ♂	2	-	-	-	-	-	43, 48.7
imm ♀	1	-	-	-	-	-	40
*Halcyon chloris *alberti* Collared Kingfisher							
adult ♂	1	-	-	1	2	-	67, 68, 70, 72
adult ♀	-	-	-	1	-	-	102
Halcyon s. saurophaga Beach Kingfisher							
adult ♂	-	-	-	-	2	1	104, 118, 137
adult ♀	-	-	-	-	-	1	127
CORACIDAE							
*Eurystomus orientalis *solomonensis* Dollarbird							
imm ♂	1	-	-	-	-	-	152
imm ♀	1	-	-	-	-	-	153
BUCEROTIDAE							
*Aceros plicatus *harterti* Blyth's Hornbill							
adult ♂	3	-	-	-	-	-	1680, 1760. 1890
adult ♀	1	-	-	-	-	-	1450
PITTIDAE							
*Pitta *anerythra anerythra* Black-faced Pitta							
adult ♂	-	2	-	-	-	-	83, 89
HIRUNDIDIDAE							
Hirundo tahitica subfusca Pacific Swallow							
imm ♂	1	-	-	-	-	-	14.6
imm ♀	1	-	-	-	-	-	15.8

CAMPEPHAGIDAE							
*Coracina lineata *nigrifrons* Yellow-eyed Cuckoo-shrike							
adult ♂	2	1	1	-	-	-	56, 60, 64.5, 71
adult ♀	5	-	1	-	-	-	49.6, 51.5, 57, 60, 60.6, 62.5
imm ♀	1	-	-	-	-	-	53.5
*Coracina papuensis *perpillada* White-bellied Cuckoo-shrike							
adult ♂	3	-	-	-	-	-	66, 68, 69.5
adult ♀	2	-	-	-	-	-	57, 67
imm ♂	1	-	-	-	-	-	67.2
imm ♀	1	-	-	-	-	-	61
*Coracina tenuirostris *saturatior* Slender-billed Cicadabird							
adult ♂	1	-	-	-	-	-	55
adult ♀	2	1	-	-	-	-	56, 57, 58.5
imm ♂	2	-	-	-	-	-	55.5, 61
imm ♀	1	-	-	-	-	-	62
*Coracina *holopolia holopolia* Solomon Islands Cuckoo-shrike							
adult ♂	3	1	-	-	-	-	41.2, 48, 51, 63
adult ♀	1	-	-	-	-	-	47.0
imm ♂	2	-	-	-	-	-	49, 52
*Coracina caledonica *welchmani* Melanesian Cuckoo-shrike							
adult ♂	1	-	1	-	-	-	156, 163
adult ♀	1	-	-	-	-	-	165
RHIPIDURIDAE							
Rhipidura leucophrys melaleuca Willie Wagtail							
adult ♂	3	-	-	1	1	-	33, 34.4, 36, 38, 39
adult ♀	5	-	-	-	-	-	28.5, 33.4, 33.5, 33.5, 33.5
imm ♂	2	-	-	-	-	-	26.5, 35
imm ♀	1	-	-	-	-	-	29.1
*Rhipidura rufifrons *commoda* Rufous Fantail							
adult ♂	1	1	-	-	-	-	12.0, 12
imm ♂	1	-	-	-	-	-	12.0
imm ♀	1	-	-	-	-	-	9.7
*Rhipidura *cockerelli interposita* White-winged Fantail							
adult ♂	1	1	-	-	-	-	16.0, 17
adult ♀	2	-	-	-	-	-	17, 18.1
imm ♀	2	-	-	-	-	-	14.5, 15.3
MONARCHIDAE							
*Monarcha *c. castaneiventris* Chestnut-bellied Monarch							
adult ♂	11	1	4	1	-	-	24.5, 25.0, 25, 25.3, 25.5, 25.5, 26.3 26.5, 27.1, 27.5, 27.5, 28, 28, 28.3, 28.4, 30.5, 32
adult ♀	3	-	2	1	-	-	22, 23, 25.5, 26.5, 27.1, 29.3
imm ♂	1	1	1	1	-	-	23, 24.6, 25, 25.5
imm ♀	1	-	-	-	-	-	24.8
*Monarcha *barbata barbata* Black-and-white Monarch							
adult ♂	6	-	1	-	-	-	20.8, 22, 22.3, 22.5, 23.5, 24.2, 24.5

adult ♂	3	2	1	-	-	-	20.8, 21.9, 23.0, 23, 23.5, 24
imm ?	2	-	-	-	-	-	22.5, 24.5
imm ♀	1	-	-	-	-	-	17.5
Monarcha cinerascens impediens Islet Monarch							
adult ♂	-	-	-	-	3	4	23.2, 23.5, 24.0, 24, 24.5, 25.5, 27
adult ♀	-	-	-	-	1	-	25.5
imm ♂	-	-	2	3	-	1	22.5, 23.5, 23.8, 24.0, 24.5, 24.5
imm ♀	-	-	3	3	1	-	21.5, 22.0, 22.1, 22.1, 23.0, 23, 24
Myiagra *f. ferrocyanea Steel-blue Flycatcher							
adult ♂	3	-	1	-	-	-	12.1, 12.1, 13, 13.1
adult ♀	1	-	-	-	-	-	13.0
imm ♂	-	1	-	-	-	-	13.5
PACHYCEPHALIDAE							
Pachycephala pectoralis *orioloides Golden Whistler							
adult ♂	6	3	-	-	-	-	45, 47, 48, 49, 52, 54, 54.5, 56, 57.5
adult ♀	1	1	-	-	-	-	41.5, 56.5
STURNIDAE							
Aplonis *grandis grandis Brown-winged Starling							
adult ♂	2	-	-	-	-	-	170, 190
adult ♀	5	-	-	-	-	-	151, 156, 178, 182, ?
Aplonis metallica nitidus Metallic Starling							
adult ♂	4	-	1	-	-	-	50.2, 51, 58, 62, 64
adult ♀	6	-	-	-	-	-	47.6, 50.5, 51.8, 53.5, 53.5, 58
imm ♀	-	-	-	1	-	-	56
Aplonis cantoroides Singing Starling							
adult ♂	-	-	-	-	2	-	51, 54.5
adult ♀	-	-	-	-	1	-	55
imm ♂	-	-	-	-	1	-	54
imm ♀	-	-	-	-	1	-	48
Mino dumontii kreffti Yellow-faced Myna							
adult ♂	5	-	-	-	-	-	194, 239, 246, 250, 262
adult ♀	5	-	-	-	-	-	190, 205, 221, 236, 242
adult ?	1	-	-	-	-	-	215
imm ♀	1	-	-	-	-	-	202
CORVIDAE							
Corvus *woodfordi vegetus White-billed Crow							
adult ♀	3	-	-	-	-	-	555, 563, 568
imm ♂	1	-	-	-	-	-	615
imm ♀	1	-	-	-	-	-	560
MELIPHAGIDAE							
Myzomela *lafargei Scarlet-naped Myzomela							
adult ♂	1	2	1	-	-	-	12.5, 12.8, 12.8, 13.0
imm ♀	-	-	1	-	-	-	12.5

NECTARINIIDAE							
Nectarinia jugularis flavigaster Olive-backed Sunbird							
adult ♂	5	-	-	-	-	1	8.8, 9.1, 9.5, 9.7, 10.0, 10.1, 10.5
adult ♀	3	-	-	-	-	-	7.1, 8.9, 9.1
imm ♂	2	-	-	-	-	-	7.7, 7.8
imm ♀	2	-	1	-	-	-	7.0, 8.0, 8.1
DICAEIDAE							
*Dicaeum *aeneum aeneum* Midget Flowerpecker							
adult ♂	5	-	-	-	-	-	7.1, 7.5, 8.3, 8.5, 8.8
adult ♀	2	-	-	-	-	-	8.5, ?
imm ♂	5	-	-	-	-	-	7.6, 7.7, 7.9, 8.2, 8.9
imm ♀	5	-	-	-	-	-	7.0, 7.3, 7.6, 7.6, 8.1
ZOSTEROPIDAE							
*Zosterops *metcalfii metcalfii* Yellow-throated White-eye							
adult ♂	5	2	-	-	-	-	12, 13.5, 14.5, 14.5, 14.5, 15.0, ?
adult ♀	2	-	-	-	-	-	13.8, 14.4
imm ♂	2	-	-	-	-	-	11.6, 14.7
imm ♀	3	-	-	-	-	-	12, 13.7, 14
imm ?	1	-	-	-	-	-	13.5
TOTAL SPECIMENS	**317**	**44**	**29**	**18**	**17**	**8**	**433**
TOTAL SPECIES	**58**	**26**	**16**	**9**	**6**	**3**	**70**

and *Nectarinia jugularis*). Females averaged larger than males in six species, all non-passerines (*Accipiter novaehollandiae, Ducula rubricera, Ninox jacquinoti, Ceyx lepidus, Halcyon leucopygia,* and *H. chloris*). Given the small sample sizes, however, only one species showed a statistically significant difference between the sexes in body mass (*Rhipidura leucophrys*, t=2.42, p=0.04, n=8).

Discussion

Although our collections include one species listed as "near-threatened" (*Corvus woodfordi*), two species listed as "vulnerable" (*Haliaeetus sanfordi*, *Pitta anerythra*) and two others (*Accipiter imitator, Nesoclopeus woodfordi*) listed as "endangered" (Collar *et al.* 1994), the population levels suggested by our fieldwork indicate that these classifications are exaggerated for all five species (Kratter *et al.* in press). Our collecting had no impact on local or island-wide populations of birds. In no case do the specimens approach 1% of the individuals of that species on Isabel, and for the majority of species, our collections represent less than 0.01% of the population.

Our data are the first on breeding and moult phenology for birds on Isabel. Only two other studies in the main archipelago of the Solomon Islands have assessed breeding cycles for entire avifaunas. On Bougainville, Schodde (1977) made an extensive collection of birds during a dry season visit (July – September) to a mid-elevation site. Sibley (1951) made a wet season visit (October – February) to the New Georgia group. We have found no data on breeding and moult in Solomon Island birds between February and late June.

Schodde detected some breeding activity in 57 of 70 species he collected on Bougainville. As was the case on Isabel, Schodde recorded little breeding activity in cuckoo-shrikes (5 of 15 specimens) and kingfishers (8 of 41 specimens). In contrast to our findings, however, he found significant breeding activity in parrots (23 of 51 specimens) and starlings (20 of 24 specimens). As Schodde's study continued for two months further into the dry season than ours, it seem likely that many parrots and starlings initiate breeding late in the dry season.

On New Georgia, Sibley (1951) found 31 of 63 specimens (49%) of adult residents with enlarged gonads; 17 of the 63 (27%) were moulting. We found fewer specimens with enlarged gonads (96 of 320, or 30% of adult specimens), although including the slightly enlarged category (91 of 320 adult specimens; Table 2) yields a percentage, 58%, similar to Sibley's. Our more detailed scoring of moult in Table 2 precludes direct comparison with Sibley's data.

The high percentage of breeding birds found in both the dry (Schodde 1977, herein) and early wet seasons (Sibley 1951) suggests that the breeding season is protracted in Solomon Island birds. Assuming that the avifaunas from different islands share a similar phenology, which seems likely given the similar climate regimes, the primary breeding season of Solomon Island birds probably continues from at least the beginning of the dry season (June) far into the wet season (February?).

To the southeast and west, respectively, Vanuatu and New Guinea share a similar wet and dry seasonality with the Solomon Islands, as well as many conspecific or closely related bird taxa. In Vanuatu, the principal breeding season of landbirds is from August to December (Marshall & Harrison 1941, Bregulla 1992). In various places in both highland and lowland New Guinea, breeding activity increases during the dry season (June - November) in most places and reaches a peak at the beginning of the rainy season (December-January), although some breeding occurs all year (Ripley 1964, Rand & Gilliard 1968, Diamond 1972, Beehler et al 1986). Our data suggest that a similar generalization may apply in the Solomon Islands.

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TABLE 2

Reproductive condition and moult data for birds collected on Isabel. Number of specimens are indicated for each age/sex class ("-" = none collected in that class). Gonads: "enl" = testes enlarged or well-developed ova or eggs; "se" = testes or ovary slightly enlarged, ova slightly enlarged; oviduct convoluted; "ne" = testes not enlarged or ovary undifferentiated. Moult (sexes combined within age categories): remiges & rectrices: "pr" = moult present (1+ feathers sheathed), "ab" = moult absent; body moult: "hm" = heavy or moderate moult; "lm" = light or trace moult; "ab" = moult absent. See Table 1 for criteria on which age determined, subspecies, English names, and site localities.

					MOULT						
			GONADS		remiges		rectrices			body	
FAMILY & species	age & sex	enl	se	ne	pr	ab	pr	ab	hm	lm	ab
ARDEIDAE											
Egretta sacra	adult ♀	1	1	-	2	-	1	1	1	1	
Nycticorax caledonicus	adult ♂	-	1	-	-	1	-	-	-	-	-
Ixobrychus flavicollis	adult ♀	1	-	-	-	1	-	1	-	-	1
	imm ♂	-	-	1	-	1	-	1	-	-	1
Butorides striatus	adult ♀	-	1	-	1	-	1	-	1	-	-
ANATIDAE											
Anas superciliosa	adult ♂	-	1	-	-	3	2	1	2	1	-
	adult ♀	2	-	-							
	imm ♂	-	-	3		-	3	-	2	1	-
ACCIPITRIDAE											
Aviceda subcristata	adult ♂	-	2	2	-	3	2	1	1	-	2
	adult ♀	1	-	1							
	imm ♀	-	-	1	-	1	-	1	-	-	1
Haliastur indus	adult ♂	-	-	1	-	1	-	1	-	-	1
Haliaeetus sanfordi	subad ♂	-	-	1	1	-	-	1	-	-	1
Accipiter novaehollandiae	adult ♂	1	-	1	1	2	1	2	1	1	1
	adult ♀	-	1	-							
	imm ♂	-	-	1	-	2	-	1	-	1	-
	imm ♀	-	-	1							
Accipiter imitator	adult ♂	1	-	-	-	1	-	1	-	-	1
MEGAPODIDAE											
Megapodius eremita	adult ♂	1	-	-							
	adult ♀	2	-	-	1	2	1	2	1	1	1
RALLIDAE											
Amaurornis moluccanus	adult ♂	-	1	-	-	1	-	1	1	-	-
Nesoclopeus woodfordi	adult ♂	-	1	1	4	3	5	1	4	2	-
	adult ♀	3	2	-							
	imm ♂	-	-	4	2	-	2	3	2	2	-
	imm ♀	-	-	1							
	chick ♀	-	-	1							
	chick sex?										
Porphyrio porphyrio	adult ♂	-	1	-	-	2	-	2	1	1	-
	adult ♀	-	1	-							
SCOLOPACIDAE											
Actitis hypoleucos	imm ♀	-	-	1	-	1	-	1	-	-	1
LARIDAE											
Sterna bergii	imm ♂	-	-	1	-	1	-	1	-	1	-

COLUMBIDAE											
Macropygia mackinlayi	adult ♂	-	2	2	2	2	2	1	1	2	-
	imm ♂	-	-	7	3	3	2	4	-	2	3
Chalcophaps stephani	adult ♀	1	-	-	-	1	-	1	-	-	1
Ptilinopus superbus	adult ♂	2	-	-	-	6	-	6	2	4	-
	adult ♀	4	-	-							
Ptilinopus viridis	adult ♂	-	2	-	2	7	-	8	1	7	-
	adult ♀	3	2	1							
Ducula rubricera	adult ♂	-	2	1	4	4	3	4	-	4	3
	adult ♀	5	-	-							
Ducula pistrinaria	adult ♂	1	-	-							
	adult ♀	1	1	-	1	2	1	2	-	2	1
Caloenas nicobarica	adult ♀	-	1	-	1	-	1	-	1	-	-
PSITTACIDAE											
Chalcopsitta cardinalis	adult ♂	-	-	7	-	7	2	5	-	1	6
	adult ♀	-	1	-							
	imm ♂	-	-	1	-	1	-	1	-	-	-
Trichoglossus haematodus	adult ♂	-	-	1	-	4	1	3	1	-	3
	adult ♀	-	1	2							
Cacatua ducorpsii	adult ♂	1	-	3	4	2	2	4	2	2	1
	adult ♀	-	1	1							
Micropsitta finschii	adult ♂	-	2	10	4	10	1	13	-	6	6
	adult ♀	-	1	1							
	imm ♂	-	-	2	-	3	-	3	-	1	1
	imm ♀	-	-	2							
Eclectus roratus	adult ♂	-	2	1	3	1	2	2	1	2	1
	imm ♂	-	-	1	1	-	-	1	1	-	-
Geoffroyus heteroclitus	adult ♀	1	-	-	-	1	-	1	1	-	-
CUCLIDAE											
Chrysococcyx lucidus	imm ♂	-	-	1	2	2	2	2	1	-	1
	imm ♀	-	-	3							
Cacomantis variolosus	imm ♀	-	-	1	1	-	-	1	1	-	-
Eudynamys scolopacea	imm ♂	-	-	1	1	-	-	1	1	-	-
STRIGIDAE											
Ninox jacquinoti	adult ♂	-	-	2	1	1	1	2	-	2	1
	adult ♀	-	1	-							
Nesasio solomonensis	adult ♀	1	-	-	-	1	-	1	-	1	-
PODARGIDAE											
Podargus ocellatus	adult ♀	-	1	-	-	1	-	1	-	1	-
APODIDAE											
Collocalia vanikorensis	adult ♀	-	-	1	1	-	1	-	-	1	-
Collocalia esculenta	adult ♂	-	-	1	-	1	-	1	-	1	-
	adult ♀	-	-	1	-	1	-	1	1	-	-
HEMIPROCNIDAE											
Hemiprocne mystacea	adult ♂	-	-	1	1	1	-	2	-	1	1
	adult ♀	1	-	-							
ALCEDINDAE											
Alcedo atthis	adult ♂	-	2	3	2	6	1	7	2	2	4
	adult ♀	-	1	3							
Ceyx lepidus	adult ♂	-	-	4	6	1	3	3	2	2	3
	adult ♀	1	2	-							
	imm ♀	-	-	1	-	1	-	1	1	-	-

Halcyon leucopygia	adult ♂	-	1	7	4	7	4	7	1	5	5
	adult ♀	1	2	-							
	imm ♂	-	-	1	1	-	1	-	-	1	-
Halcyon sancta	adult ♂	-	-	1	-	2	2	-	1	1	-
	adult ♀	-	-	1							
	imm ♂	-	-	2	1	2	2	-	2	1	-
	imm ♀	-	-	1							
Halcyon chloris	adult ♂	-	1	3	2	3	1	4	1	-	2
	adult ♀	1	-	-							
Halcyon saurophaga	adult ♂	-	1	1	2	2	2	2	1	1	2
	adult ♀	-	-	1							
CORACIDAE											
Eurystomus orientalis	imm ♂	-	1	-	-	2	-	2	-	1	-
	imm ♀	-	-	1							
BUCEROTIDAE											
Aceros plicatus	adult ♂	3	-	-	-	4	-	4	-	1	-
	adult ♀	1	-	-							
PITTIDAE											
Pitta anerythra	adult ♂	-	-	2	1	1	-	2	-	-	1
HIRUNDIDIDAE											
Hirundo tahitica	imm ♀	-	-	1	2	-	2	-	-	-	-
	imm ♂	-	-	1							
CAMPEPHAGIDAE											
Coracina lineata	adult ♂	-	1	3	4	6	3	7	2	7	-
	adult ♀	-	5	1							
	imm ♀	-	-	1	1	-	-	1	-	1	-
Coracina papuensis	adult ♂	-	-	3	1	4	-	5	2	1	-
	adult ♀	-	1	1							
	imm ♂	-	-	1	1	1	-	2	2	-	-
	imm ♀	-	-	1							
Coracina tenuirostris	adult ♂	-	-	1	-	4	1	3	1	2	-
	adult ♀	2	1	-							
	imm ♂	-	-	1	-	3	1	2	-	2	-
	imm ♀	-									
Coracina holopolia	adult ♂	-	-	4	-	5	1	4	2	2	1
	adult ♀	1	-	-							
	imm ♂	-	-	1	1	1	1	1	2	-	-
Coracina caledonica	adult ♂	-	1	1	-	3	1	2	-	1	1
	adult ♀	1	-	-							
RHIPIDURIDAE											
Rhipidura leucophrys	adult ♂	4	-	1	4	6	5	5	1	1	6
	adult ♀	3	2	-							
	imm ♂	-	-	1	1	2	1	2	1	-	2
	imm ♀	-	-	1							
Rhipidura rufifrons	adult ♂	1	1	-	-	2	-	2	-	-	1
	imm ♂	-	-	1	1	1	1	1	-	1	-
	imm ♀	-	-	1							
Rhipidura cockerelli	adult ♂	2	-	-	-	4	-	4	-	-	4
	adult ♀	1	1	-							
	imm ♀	-	-	2	-	2	-	2	-	-	2
MONARCHIDAE											
Monarcha castaneiventris	adult ♂	9	2	5	11	12	7	15	9	1	11
	adult ♀	1	1	4							

	imm ♂	-	-	4	1	4	-	5	-	-	5
	imm ♀	-	-	1							
Monarcha barbata	adult ♂	4	-	3	5	7	3	9	3	1	6
	adult ♀	2	-	4							
	imm ♂	-	1	1							
	imm ♀	-	-	1	-	3	-	3	-	1	2
Monarcha cinerascens	adult ♂	6	-	1	2	6	-	8	2	-	6
	adult ♀	1	-	-							
	imm ♂	-	-	6	3	11	1	13	2	2	10
	imm ♀	-	-	7							
Myiagra ferrocyanea	adult ♂	-	2	2	-	5	-	5	-	-	5
	adult ♀	-	-	1							
	imm ♂	-	-	1	1	-	1	-	1	-	-
PACHYCEPHALIDAE											
Pachycephala pectoralis	adult ♂	9	-	-	5	6	5	5	2	3	5
	adult ♀	2	-	-							
STURNIDAE											
Aplonis grandis	adult ♂	-	-	2	2	3	-	5	1	-	4
	adult ♀	-	2	3							
Aplonis metallica	adult ♂	-	-	5	-	11	-	11	-	-	11
	adult ♀	-	2	4							
	imm ♀	-	-	1	-	1	-	1	-	1	-
Aplonis cantoroides	adult ♂	1	-	-	1	2	1	2	-	2	1
	adult ♀	-	-	1							
	imm ♂	-	-	1	-	2	-	2	-	2	-
	imm ♀	-	-	1							
Mino dumontii	adult ♂	-	4	1	8	3	6	5	2	3	4
	adult ♀	-	2	3							
	adult ?	1 (not sexed)									
	imm ♀	-	-	1	-	1	-	1	-	1	-
CORVIDAE											
Corvus woodfordi	adult ♀	-	3	1	3	-	1	2	2	-	-
	imm ♂	-	-	1	2	-	2	-	2	-	-
	imm ♀	-	1		-						
MELIPHAGIDAE											
Myzomela lafargei	adult ♂	-	4	-	-	4	-	4	-	2	2
	imm ♀	-	-	1	-	1	-	1	-	-	-
NECTARINIIDAE											
Nectarinia jugularis	adult ♂	6	1	-	2	8	1	8	2	2	3
	adult ♀	-	2	1							
	imm ♂	-	-	2	-	5	2	3	1	-	3
	imm ♀	-	-	3							
DICAEIDAE											
Dicaeum aeneum	adult ♂	-	1	2	-	6	-	6	1	3	1
	adult ♀	-	-	2							
	imm ♂	-	-	5	-	10	-	10	2	1	7
	imm ♀	-	-	5							
ZOSTEROPIDAE											
Zosterops metcalfii	adult ♂	3	3	1	2	7	4	5	-	1	5
	adult ♀	-	2	-							
	imm ♂	-	-	2	4	2	1	5	-	2	1
	imm ♀	-	-	3							
	imm ?	1 (not sexed)									

References:

Beehler, B. M., Pratt, T. K. & Zimmerman, D. A. 1986. *Birds of New Guinea*. Princeton Univ. Press, New Jersey.

Blaber, S. J. M. 1990. A checklist and notes on the current status of the birds of New Georgia, Western Province, Solomon Islands. *Emu* 90:205-214.

Bregulla, H. L. 1992. *Birds of Vanuatu*. Anthony Nelson, Shropshire, U. K.

Cain, A. J., & Galbraith, I. C. J. 1956. Field notes on birds of the eastern Solomon Islands. *Ibis* 98: 100-134.

Collar, N. J., Crosby, M. J. & Stattersfield, A. J. 1994. Birds to Watch 2. *BirdLife Conservation Series* No. 4.

Diamond, J. M. 1972. Avifauna of the eastern highlands of New Guinea. *Publ. Nuttall Orn. Club* 12.

Dunning, J. B., Jr. 1993. *CRC Handbook of avian body masses*. CRC Press, Boca Raton, Florida.

Fogden, M. P. L. 1972. The seasonality and population dynamics of equatorial forest birds in Sarawak. *Ibis* 114: 307-343.

Franklin, J., & D. W. Steadman. 1991. The potential for conservation of Polynesian birds through habitat mapping and species translocation. *Conservation Biology* 5: 506-521.

Galbraith, I. C. J. & Galbraith, E. H. 1962. Land birds of Guadalcanal and the San Cristoval group, eastern Solomon Islands. *Bull. Brit. Mus. (Nat. Hit.), Zool.* 9: 1-86.

Kratter, A. W., Steadman, D. W., Smith, C. E., Filardi, C. E. & Webb, H. P. In press. The avifauna of a lowland forest site on Isabel, Solomon Islands. *Auk*.

Marshall, A. J. & Harrison, T. H. 1941. The comparative economy of closely related birds on an island and a continent. *Emu* 40: 310-318.

Rand, A. L. & Gilliard, E. T. 1968. *Handbook of New Guinea birds*. Natural History Press, Garden City, New York.

Ripley, S. D. 1964. A systematic and ecological study of birds in New Guinea. *Peabody Mus. Nat. Hist. Bull.* 19.

Schodde, R. 1977. Survey of birds of southern Bougainville Island, Papua New Guinea. *Contributions to Papuasian ornithology* VI. Commonwealth Scientific and Industrial Research Organization, Australia.

Sibley, C. G. 1951. Notes on the birds of New Georgia, central Solomon Islands. *Condor* 53: 81-92.

Stattersfield, A. J., Crosby, M. J., Long, A. J. & Wege, D. C. 1998. *Endemic bird areas of the world*. BirdLife International, Cambridge, U. K.

Steadman, D. W. 1995. Prehistoric extinction of Pacific island birds: biodiversity meets zooarchaeology. *Science* 267: 1123-1131.

Steadman, D. W., Greiner, E. C. & Wood, C. S. 1990. Absence of blood parasites in indigenous and introduced birds from the Cook Islands, South Pacific. *Conservation Biology* 4: 398-404.

Webb, H. P. 1992. Field observations of the birds of Santa Isabel, Solomon Islands. *Emu* 92: 52-57.

Winker, K. 2000. Obtaining, preserving, and preparing bird specimens. *J. Field Ornithology* 71: 250-297.

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